

# Small Polarimetric Adaptive Array for Airborne GPS Jammer Suppression

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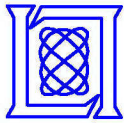
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**Abstract** MIT Lincoln Laboratory has designed, built, tested, and analyzed a small polarimetric adaptive array for airborne GPS jammer suppression. The array has 7 channels and is configured as a square array. The array consists of a right-hand circularly polarized (RHCP) reference element and 3 dual-linearly polarized elements. The rationale for the design was to create a 7-channel array with 1 RHCP reference element that had acceptable levels of mutual coupling and fit within a 7 inch by 7 inch footprint. The approach taken was to convert 3 of the 4 elements of a 4-element RHCP array to 3 dual-linearly polarized elements. This modification actually simplifies the construction of the array by eliminating 3 hybrid couplers. This modification results in up to 6 degrees of freedom for the polarimetric array.

The concept of using dual-polarized elements in an adaptive array was considered by R.T. Compton, Jr. and presented in his text *Adaptive Antennas*. He showed that using dual-polarized elements allows a polarization null to be directed towards an interfering source while receiving a desired signal that is co-linear with the interferer and the receiver, provided the desired signal and the interfering signal have somewhat different polarizations. He also showed that using an array with different element patterns can have better performance than an array of isotropic elements under certain conditions.

This paper will concentrate on the measured performance of the small polarimetric adaptive array. The complex element patterns of the array were measured on a small ground plane in an MIT Lincoln Laboratory indoor chamber, and a few azimuthal patterns were measured with the array on a Falcon 20 aircraft in the Patuxent River Chamber. These two data sets show the effects of diffraction from the aircraft wings and fuselage on the antenna patterns. Adaptive patterns and anti-jam improvement factors for the array on the aircraft in a jamming environment when connected to a digital space-time adaptive processor (STAP), known as MAMBA, will also be shown. The MAMBA processor and the small polarimetric array were developed by MIT Lincoln Laboratory under DARPA sponsorship and GPS JPO sponsorship, respectively.

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# SMALL POLARIMETRIC ADAPTIVE ARRAY FOR AIRBORNE GPS JAMMER SUPPRESSION\*

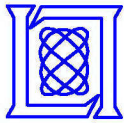
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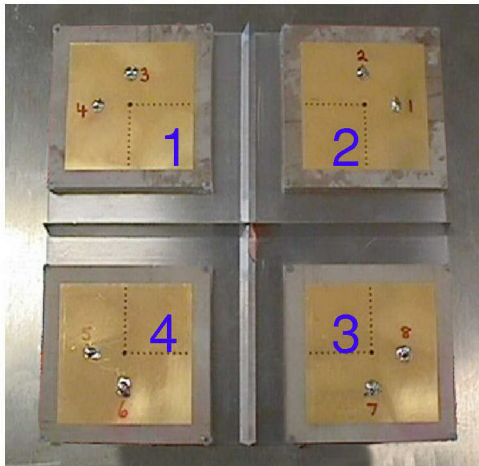
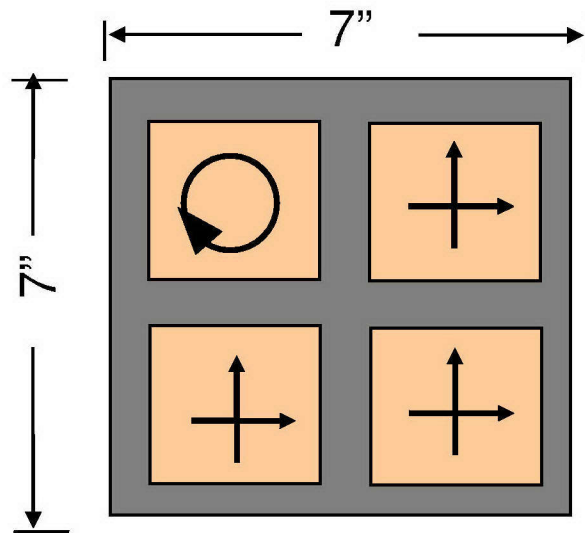
Adaptive Sensor Array Processing

16-18 March 2004

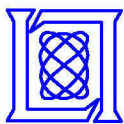
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# GPS Polarimetric Adaptive Array



- 7 channels
  - 3 dual-linear
  - 1 RHCP
- 7" square aperture
  - 1/3 the area of the 14" CRPA
- $\sim \lambda/2$  spacing at  $L_1$
- Superior nulling performance to 4-element RHCP array
- Up to 6 degrees of freedom

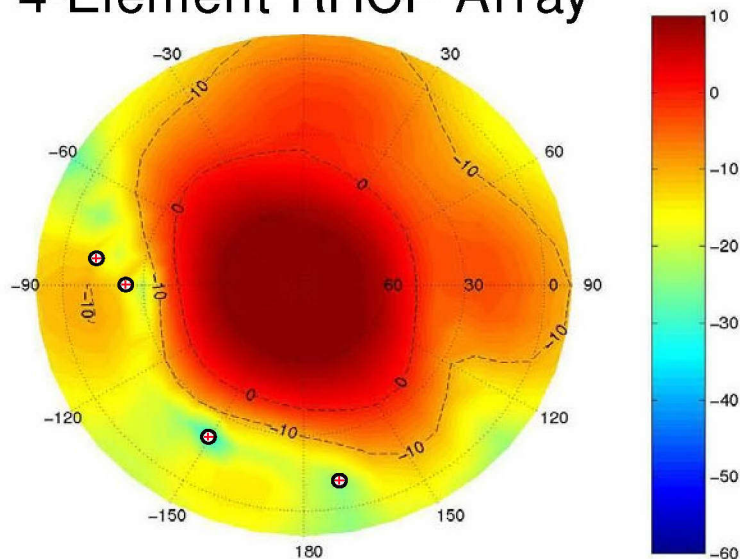


# MIT LL Polarimetric Array

## Conventional 4-Element RHCP Array vs Polarimetric Array

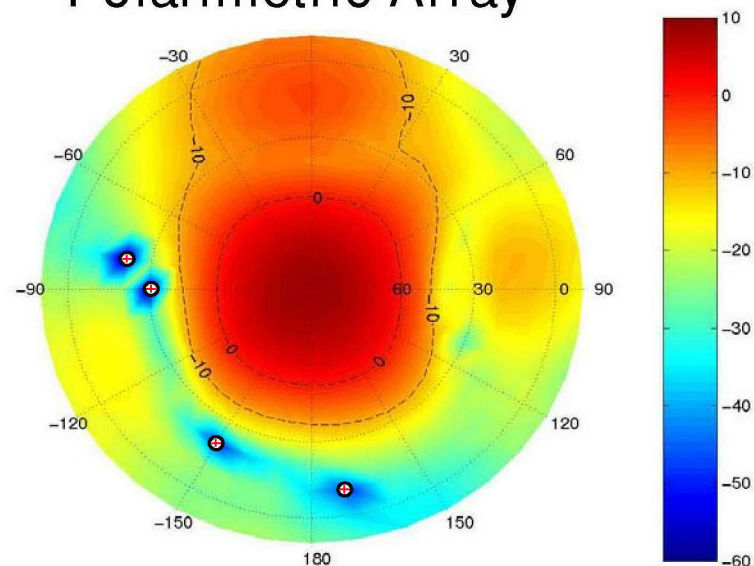
4 RHCP Jammers @  $L_1$

4-Element RHCP Array



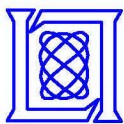
- Null depths ~ -25 dB

Polarimetric Array



- Null depths ~ -50 dB

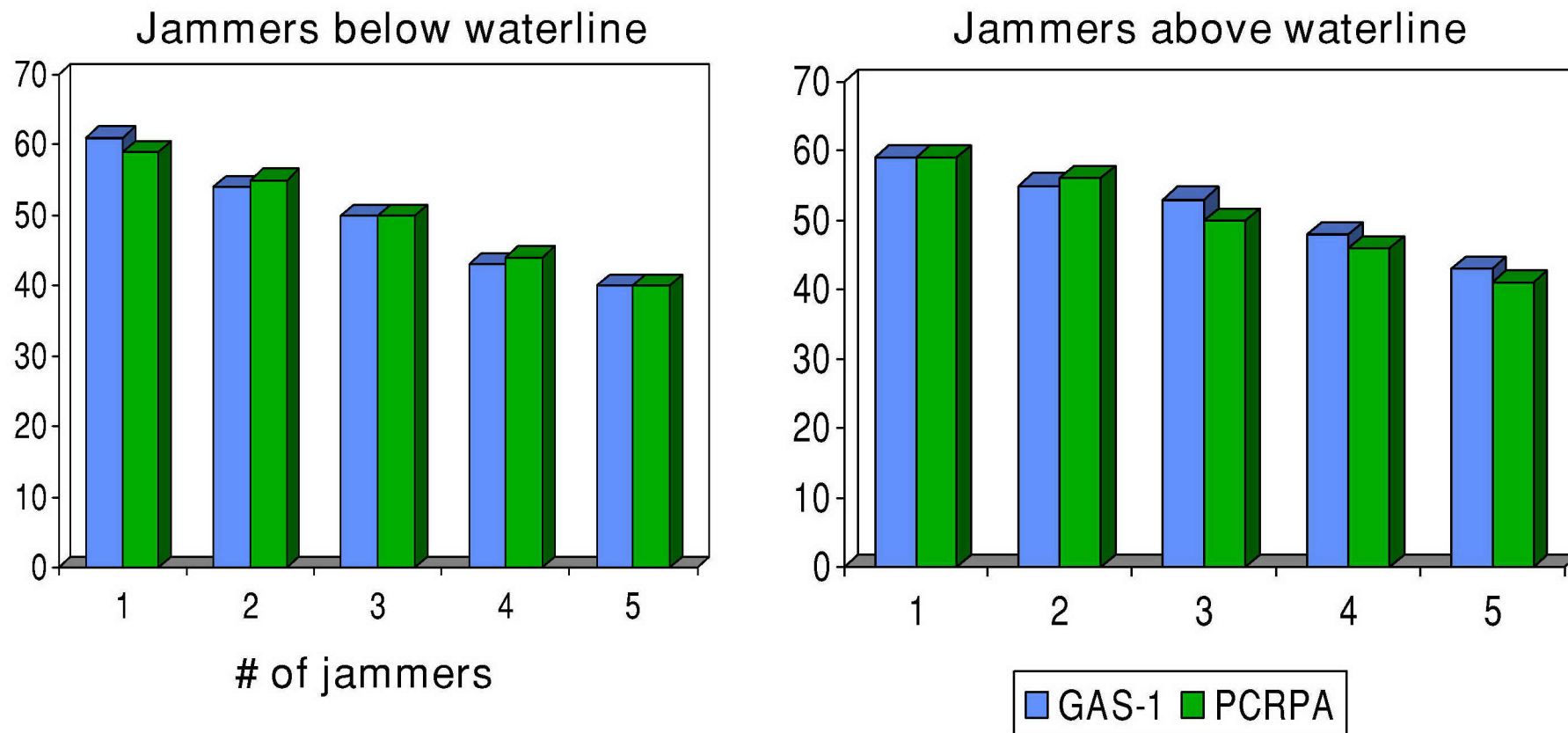
⊕ Jammer Locations



# MIT LL Small PCRPA vs. 14in CRPA

Wideband noise STAP Beamformer Pax Chamber Test

Mean A/J improvement factor (dB)



All results for  $L_2$